

December 6, 2017

MEMORANDUM TO: Samuel S. Lee, Chief
Licensing Branch 1
Division of New Reactor Licensing
Office of New Reactors

FROM: Marieliz Vera Amadiz, Project Manager /RA/
Licensing Branch 1
Division of New Reactor Licensing
Office of New Reactors

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION STAFF REPORT
OF THE REGULATORY AUDIT FOR THE NUSCALE POWER,
LLC DESIGN CERTIFICATION APPLICATION FINAL SAFETY
ANALYSIS REPORT CHAPTER 3, SECTION 3.13, "THREADED
FASTENERS (AMERICAN SOCIETY OF MECHANICAL
ENGINEERS CODE CLASS 1, 2, AND 3)"

On January 6, 2017, NuScale Power, LLC (NuScale) submitted a design certification (DC) application for a Small Modular Reactor to the U.S. Nuclear Regulatory Commission (NRC) (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17013A229). The NRC staff started its detailed technical review of NuScale's DC application on March 27, 2017.

The NRC staff conducted an audit of the threaded fastener design drawings and specifications associated with NuScale DC application, Final Safety Analysis Report (FSAR), Section 3.13, "Threaded Fasteners (ASME Code Class 1, 2, and 3)." The audit was conducted from July 5, 2017 to September 21, 2017, in accordance with the audit plan (ADAMS Accession No. ML17179A250).

The purpose of the audit was to: (1) gain a better understanding of information in the area of threaded fasteners and the use of threaded inserts; and (2) identify information that will require docketing to support the basis of the licensing or regulatory decision. Specifically, the audit was performed to review the design drawings and specifications in the area of threaded fasteners, and understand the use of threaded inserts in the NuScale design.

The NRC staff conducted the audit at via access to NuScale's electronic reading room. The audit was conducted in accordance with the NRC's Office of New Reactors (NRO) Office Instruction, NRO-REG-108, "Regulatory Audits" (ADAMS Accession No. ML081910260).

CONTACT: Marieliz Vera Amadiz, NRO/DNRL
301-415-5861

S. Lee

- 2 -

The publicly available version of the audit report and the audit attendee list are enclosed with this memorandum.

Docket No. 52-048

Enclosures:

1. Audit Report
2. Attendee List

cc: NuScale DC ListServ

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION STAFF REPORT OF THE
 REGULATORY AUDIT FOR THE NUSCALE POWER, LLC DESIGN
 CERTIFICATION APPLICATION FINAL SAFETY ANALYSIS REPORT CHAPTER
 3, SECTION 3.13, "THREADED FASTENERS (AMERICAN SOCIETY OF
 MECHANICAL ENGINEERS CODE CLASS 1, 2, AND 3)"
 DATED: _____

DISTRIBUTION:

PUBLIC

LB1 R/F

SLee, NRO

MVera, NRO

JHuang, NRO

MMoore, NRO

MMitchell, NRO

GCranston, NRO

NMcMurray, NRO

RidsNroDnrLB1

RidsOgcMailCenter

RidsOpaMailCenter

RidsAcrcAcnwMailCenter

ADAMS Accession No.: ML17335A105

*via email

NRO-002

OFFICE	NRO/DNRL/LB1: PM	NRO/DNRL/LB1: LA	NRO/DEI/MCB: BC	NRO/DNRL/LB1: PM
NAME	MVera	MMoore*	MMitchell*	MVera*
DATE	11/30/2017	12/05/2017	12/06/2017	12/06/2017

OFFICIAL RECORD COPY

U.S. NUCLEAR REGULATORY COMMISSION
NUSCALE POWER, LLC
SUMMARY REPORT OF THE AUDIT REGARDING
THE USE OF THREADED FASTENERS IN THE NUSCALE DESIGN

INTRODUCTION AND BACKGROUND

The design and inspection of the pressure-retaining bolts, studs, nuts, and washers (collectively referred to as threaded fasteners) for the NuScale Power, LLC (NuScale) design are mainly described in Design Certification Document (DCD) Tier 2, Final Safety Analysis Report (FSAR), Section 3.13, "Threaded Fasteners (ASME Code Class 1, 2, and 3)." Threaded fasteners are used throughout the design to maintain the pressure boundary of the reactor pressure vessel (RPV) and containment vessel (CNV).

During the U.S. Nuclear Regulatory Commission (NRC) staff's review of the DCD, several safety significant locations where threaded inserts are used were identified:

- CNV bolting including the upper shell assembly and inspection port and manway covers (Section 6.1.1.1 "Material Selection and Fabrication" and Table 6.1-1 "Material Specifications for ESF Components"); and
- RPV flange studs (Table 6.2-4 "Containment Penetrations").

The FSAR does not contain information related to the design of the threaded inserts, and does not fully describe the scope of which threaded fasteners will use a threaded insert. The DCD states that the threaded inserts are manufactured out of SA-479, Type 304/304L stainless steel.

The threaded inserts provide a barrier between the borated water and the low alloy steel. Therefore, in order to maintain the structural integrity of the low alloy steel, the threaded inserts and attachment welds need to remain leak tight.

Furthermore, the threaded fasteners for the inspection ports, manway covers, and flanges are part of the RPV and CNV pressure boundaries. Therefore, the threaded inserts have a structural function to maintain the pressure boundaries.

The NRC staff determined it would be advantageous to audit information supporting the use of threaded fasteners, and specifically threaded inserts. The NRC staff intended to audit information related to how the threaded inserts are designed and the controls that are in place to ensure their integrity during normal, testing, refueling, and accident conditions.

The NRC staff performed a review of the design documents for the NuScale RPV and CNV. During the NRC staff's review, the staff ensured that the DCD accurately described where threaded fasteners are used in accordance with the design drawings. The NRC staff then reviewed the design and scope of use of the threaded inserts.

During the course of the review, the NRC staff identified a design feature that was not described in the DCD. The NuScale design uses “lock plates” to hold the RPV and CNV main flange studs in place to allow the fastener bolts to be inserted from below. The lock plates are connected to the top RPV and CNV main flanges by studs which are screwed into the top flange and have a weld around the stud into the flange.

Similar to the threaded inserts, the lock plate stud welds provide a corrosion barrier to the base metal, and these welds are subject to stresses during refueling tensioning and de-tensioning. Therefore, the NRC staff requested additional information, including potential augmented inspections, related to the threaded inserts and lock plates to ensure that the welds will not degrade during service.

The NRC staff will submit a request for additional information (RAI) related to the installation and inspection (construction and inservice) of the welds. The RAI will also request information related to the welding procedures and inspections that will be performed on the welds during fabrication/installation.

The audit provided the NRC staff the opportunity to engage with NuScale to further understand the use of threaded fasteners in the NuScale design. The audit has better prepared the NRC staff for a more efficient and timely review since the staff was able to confirm information in the DCD regarding threaded fasteners.

REGULATORY AUDIT BASES

This technical audit was based on the following regulatory requirements:

- Title 10 of the *Code of Federal Regulations* Section 52.47 (10 CFR 52.47), “Contents of applications; technical information in final safety analysis report.”
- General Design Criteria (GDC) 1, “Quality Standards and Records,” of Appendix A to 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities,” requires that structures, systems, and components (SSC) important to safety shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed.
- GDC 4, “Environmental and Dynamic Effects Design Bases,” requires that SSCs important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents.

The audit followed the guidelines in the Office of New Reactors (NRO) Office Instruction NRO-REG-108 (Revision 0), “Regulatory Audits” [Reference 1].

NRC AUDIT TEAM

Nicholas R. McMurray
Jason Huang

Materials Engineer
Mechanical Engineer

(NRO/DEI/MCB)
(NRO/DEI/MEB)

AUDIT PREPARATION

The NRC staff issued a detailed audit plan [Reference 2] that identified the information needed for the audit. The audit plan requested documentation related to the use of threaded inserts in the NuScale design. The NRC staff expected NuScale to furnish the documents that would support the resolution of the audit.

DOCUMENTS PROVIDED BY NUSCALE FOR THE AUDIT

Below is a list of the design drawings and specifications that were made available to the audit team to support the requests made in the audit plan. The NRC staff examined these documents, as needed. The NRC staff notes that engineering change notice (ECN) documents that follow a design drawing or specification made a change to that referenced design drawing or specification revision.

Document Number	Document Name	Revision	Dated
2016.04.21 NP12-01-A023-M-GA-2303_R1 stamped.pdf	Reactor Vessel Internals - Upper Riser	R1	Dated 4/21/2016
ECN-A023-4345	Reactor Vessel Internals - Upper Riser BOM and Note Changes	N/A	Dated 8/23/2016
2016.05.11 NP12-01-A023-M-GA-1958 stamped.pdf	Reactor Vessel Internals	R2	Dated 5/11/2016
Draft Response 170828 for Section 3.13 Audit.pdf	Response to NRC Audit Questions on 3.13	R0	Dated 8/19/2017
EQ_A011_1775_R1_ASME Design Specification for Reactor Pressure Vessel.pdf	ASME Design Specification for Reactor Pressure Vessel	R1	Dated 11/10/2016
EQ_A013_1826_R1_ASME Design Specification for Containment_Vessel.pdf	ASME Design Specification for Containment Vessel	R1	Dated 11/18/2016
ECN-A013-5384	Change to Hydrostatic Testing Requirements		Dated 6/8/2017
EQ_A023_1943_R1_ASME Design Specification for Reactor Vessel Internals.pdf	ASME Design Specification for Reactor Vessel Internals	R1	Dated 11/14/2016
ER_A010_2186_R0_Reactor_Module_Test_and_Inspection_Elements.pdf	Reactor Module Test and Inspection Elements	R0	Dated 7/20/2016
ECN-A010-5005	Reactor Module Test and Inspection Elements Updates	N/A	Dated 12/16/2016
NP12-01-A010-M-SA-2604_R0_Approved.pdf	CNV-RPV Closure Bolts	R0	Dated 4/27/2015
ECN-A010-4030	CNV-RPV Closure Bolt reference change	R0	Dated 9/22/2016
NP12-01-A011-M-SA-2645-R2 RPV Head Section.pdf	RPV Head Section	R2	Dated 4/8/2016
ECN-A011-4985	RPV Head Missing Dimension Update	N/A	Dated 12/16/2016
NP12-01-A011-M-SA-2658-R2 Upper RPV Section.pdf	Upper RPV Section	R2	Dated 4/5/2016
ECN-A011-5134	Upper RPV Section BOM updates and Note Changes	N/A	Dated 2/6/2017
ECN-A011-4984	Upper RPV Section Dimension Additions	N/A	Dated 12/14/2016

NP12-01-A013-M-GA-1933_R3 stamped.pdf	Containment Vessel Assembly	R3	Dated 4/7/2016
ECN-A013-4420	Remove Passive Support Skirt	N/A	Dated 8/23/2016
ECN-A013-4397	Excure Detector Removal	N/A	Dated 8/22/2016
NP12-01-A013-M-GA-2602_REV3 Upper CNV Section.pdf	CNV Upper Section	R3	Dated 5/30/2017
NP12-01-A013-M-GA-2603_R1 signed.pdf	CNV Top Head Assembly	R1	Dated 3/31/2016
ECN-A013-4404	CNV Top Head Assembly Bill of Materials Update and Note Changes	N/A	Dated 8/11/2016
ECN-A013-4333	CNV Top Head Dimensioning and Fabrication Changes	N/A	Dated 9/14/2016
NP12-01-A023-M-GA-2305 R1 Reactor Vessel Internals-Core Support.pdf	Reactor Vessel Internals - Core Support	R1	Dated 3/16/2017
NP12-01-A023-M-GA-2637_R0 approved.pdf	RPV Surveillance Capsule	R0	Dated 7/13/2015

CONCLUSIONS

The NRC staff concludes that overall the audit was productive and the staff was able to gain an understanding of the use of threaded fasteners in the NuScale design. NuScale agreed to respond to the staff's RAI that will be based on the staff's observations.

REFERENCES

1. NRO-REG-108, "Regulatory Audits", April 2, 2009 (ADAMS Accession No. ML081910260).
2. "Audit Plan for Regulatory Audit of NuScale Section 3.13, Threaded Inserts," dated June 29, 2017 (ADAMS Accession No. ML17179A250).

U.S. NUCLEAR REGULATORY COMMISSION
AUDIT OF NUSCALE POWER, LLC
DESIGN CERTIFICATION APPLICATION,
FINAL SAFETY ANALYSIS REPORT,
CHAPTER 3, SECTION 3.13, "THREADED FASTENERS (AMERICAN SOCIETY OF
MECHANICAL ENGINEERS CODE CLASS 1, 2, AND 3)"

LIST OF ATTENDEES

July 5, 2017 - September 21, 2017

NRC Staff Participants:

Nicholas R. McMurray
Jason Huang
Marieliz Vera

NuScale (and Other Support Organization) Participants:

Matt Mallet
HQ Xu
Steve Unikewicz
Tom Ryan
Randy Morrill
Marty Bryan